HIGH ASPIRATIONS

New horizons—and new altitudes—are opening for general aviation pilots caught up in the popularity of turbocharging. Here's a look at the environment one can expect in the rarefied air above 12,500 feet and the airplanes that get you there.

TURBO ARROW IV

A boost up.

BY MARK M. LACAGNINA

Modifying a proven airframe involves a gamble. When Piper Aircraft Corporation turbocharged the Arrow four years ago, it was betting tight development money that pilots would be willing to pay a few thousand dollars more for the extra performance that would allow them to cope better with high density altitude and to climb more readily above adverse weather.

Aircraft delivery figures show the gamble paid off in an expansion of the market for the popular Arrow. Piper delivered 410 Arrows in 1976. The debut of the Turbo Arrow coincided with the introduction of semitapered wings on the Arrow III models in 1977. That year, Piper delivered a total of 676 Arrows, including 272 normally aspirated models and 404 Turbo Arrows.

The Turbo Arrow continued to outsell the normally aspirated model during the next two years, but total deliveries slipped from 691 in 1978 to 589 in 1979. The downturn in the market could be attributed, of course, to the advent of tight credit and to rising interest rates and fuel costs. But 1979 also marked another gamble for Piper—it stuck a T-tail on the Arrow. And pilots just did not accept that as the right way to go with the airplane. A T-tail, after all, had not worked for the Lance II. Pilots found the pitch characteristics different from those they were accustomed to in the conventional-tail Lance. The T-tail Lance requires more runway on takeoff, and pilots found it difficult to keep the nosewheel off the runway while landing.

Piper has gone back to conventional tails on the new Saratogas, successors to the Lance series (*AOPA Pilot*, February, p. 35), but is sticking with the T-tail on the Arrow. The company feels a T-tail does not cause the problems for the Arrow IV that it did for the heavier Lance II. And the design of the T-tail on the Arrow is different from that on the Lance II. The Arrow IV's tail has slots in the leading edge of the horizontal stabilator and plates between the inboard edges of the stabilator and the fairings between the vertical and the horizontal tail surfaces (*AOPA Pilot*, March 1979, p. 38). The slots and plates improve the effectiveness of the stabilator at low airspeeds.

The difference in tail designs involves a number of performance tradeoffs between the Arrow III and Arrow IV models. In flying both the Turbo Arrow III and Turbo Arrow IV, I found the T-tail model requires muscle and a good amount of aft trim for rotation and landing; the conventional-tail Turbo Arrow III requires much less effort on rotation and uses less runway on normal takeoffs. Without the benefit of propeller wash on the stabilator, it is harder to maneuver the Turbo Arrow IV on muddy or wet grass ramps.

The advantages of the T-tail are apparent in flight. Pitch changes are much less noticeable when landing gear and flaps are lowered. Maximum-gear-extension speed for the Turbo Arrow IV is 133 knots, four knots higher than the Turbo Arrow III. Maximum-flap-extended speed for the Turbo Arrow IV is 108 knots, five knots higher.

In addition to the economic crunch and poor public acceptance of the T-tail, the decline in the market for the Arrow IVs in the past few years can be attributed to competition from Mooney's new 201 and 231 models. The Turbo Arrow IV and the turbocharged Mooney 231 (210 hp) cost about the same, but the 231 is much faster and can operate at higher altitudes. The Turbo Arrow IV, however, has a significant edge on the 231 in payload.

The Turbo Arrow IV is powered by a six-cylinder Teledyne Continental TSIO-360-FB engine, which Piper first used on the Seneca twin. The normally aspirated Arrow IV has a four-cylinder, Lycoming IO-360-C1C6 engine. While both engines are rated for 200 horsepower, the recommended time between overhauls (TBO) for the Continental is 1,800 hours, compared with 1,600 hours for the Lycoming. The recommended TBO for the Rajay turbocharger recently was raised from 1,000 to 1,800 hours. Both the two- and the three-blade Hartzell propellers on the Turbo Arrow IV have TBOs of 1,000 hours.

The turbocharger has a fixed-wastegate system that is adjusted to provide 41 inches of manifold pressure at full throttle at a density altitude of 12,000 feet. The turbocharged engine can maintain its rated 200 horsepower from sea level to its critical altitude of 12,000 feet. Above this, the engine loses about one inch of MP at full throttle for each 1,000-foot increase in density altitude. The normally aspirated engine in the Arrow IV loses a portion of its rated power for each incremental increase in density altitude above sea level.

The turbocharger has an overboost valve that is supposed to prevent manifold pressure from exceeding 42 inches,

PHOTOGRAPHY BY ART DAVIS

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Semitapered wings, a T-tail and a turbocharger trace the evolution of a popular retractable.

if the throttle is opened too far at altitudes below 12,000 feet. But it would be unwise to bet overhaul money on this valve. Given free rein by ham-handed throttle technique, the turbocharger will overboost and scrap the engine.

The turbocharger adds appreciably to the Arrow's performance. According to Piper's information manuals, the Turbo Arrow is about four knots faster at sea level and about 14 knots faster at 12,000 feet than the normally aspirated Arrow. At best-rate-of-climb speed, the Turbo Arrow takes about 32 minutes to climb from sea level to its maximum operating altitude of 20,000 feet. (Piper says the airplane can climb at better than 100 fpm above 20,000 feet, but was certificated at this altitude because of operational considerations of its gyro pressure systems.) In comparison, the Arrow requires more than 45 minutes to climb from sea level to its service ceiling of 16,000 feet.

The Turbo Arrow IV that I flew for this report is a 1980 model owned by three business partners who lease it back to a fixed-base operator for rental. The airplane, N8242L, is really loaded with options, including a three-blade propeller, an Autocontrol IIIB autopilot, electric pitch trim and a full King panel with a KNS-80 area navigation system, a KY-197 transceiver, a KX-170 nav/com, a KR-86 automatic direction finder as well as a KMA-20 audio panel.

Pilots familiar with the normally aspirated Arrow will have little difficulty transitioning to the Turbo Arrow. Of prime importance is careful attention to power management. Valuable information on proper engine operation is available in a Continental manual for the TSIO-360-FB engine.

The basic panel in the Turbo Arrow is similar to that of the Arrow, except for the presence of an overboost warning light on the annunciator panel, a three-position auxiliary-fuel-pump rocker switch and a manifold-pressure-line drain valve. The overboost light will illuminate when manifold pressure exceeds 41 inches (redline on the gauge). The top of the auxiliary-fuel-pump switch is labeled LO and can be depressed to suppress vapor pressure in the fuel lines, if the engine begins running rough while idling or while operating at high density altitudes. The HI setting on the bottom of the switch is guarded by a manually operated latch and should be used only if the engine-driven fuel pump fails. The manifold-pressure-line drain valve is located behind the bottom left-hand side of the panel, out of sight. It is depressed for about five seconds during runup at about 1,000 rpm to expell any moisture or any fuel that may have accumulated in the manifold pressure line as a result of overpriming the engine during the start. The drain valve is needed in the Turbo Arrow because any accumulated moisture or fuel could be forced up into the manifold pressure gauge when pressure within the line increases above about 30 inches. At lower pressures, moisture and fuel are pulled back up into the engine.

Soft velour seats and hard King avionics are some of the features offered as options.

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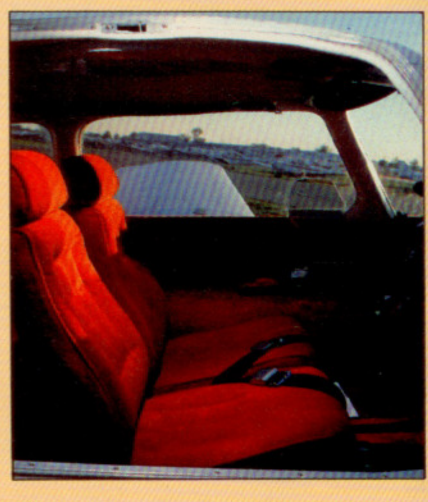
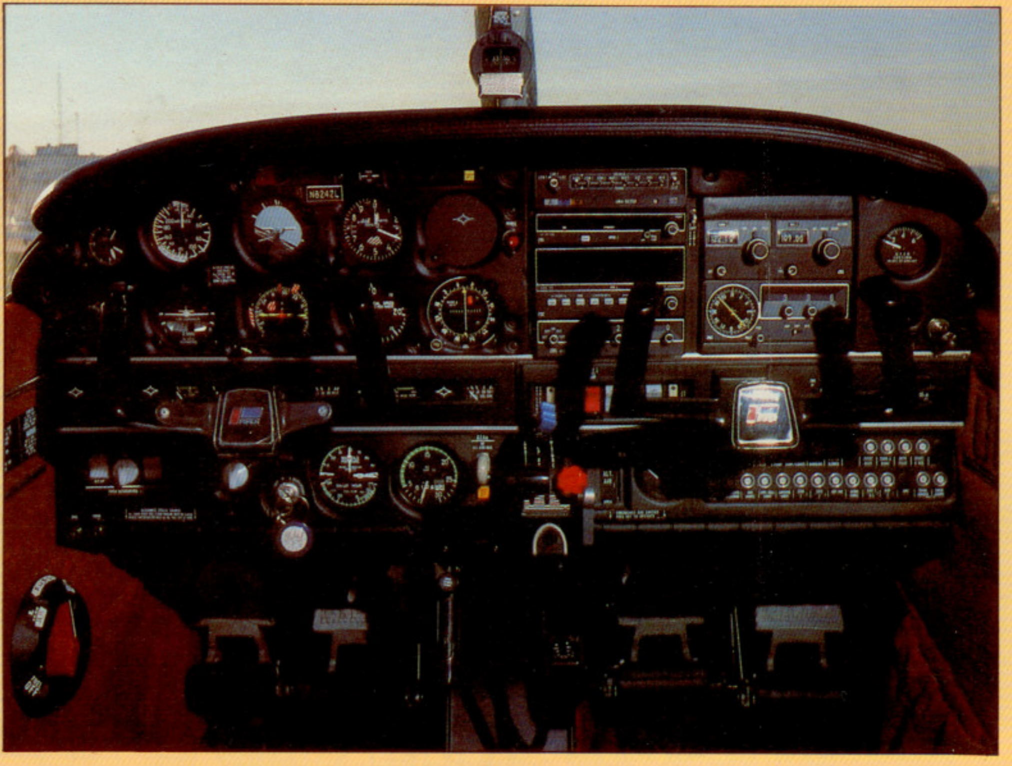


N8242L is equipped with the op-



tional engine primer system, which is designed specifically to aid engine starts in cold weather. Set the mixture control to Full Rich and push the throttle and prop controls full forward. Depress the spring-loaded primer button on the panel for about two seconds, close the throttle and engage the starter. I followed this procedure during engine starts in a variety of ambient temperatures; each time, the engine rumbled to life on cue.

The main shaft of the turbocharger is lubricated by engine oil. Therefore, the engine should be operated at between 1,000 and 1,200 rpm until the engine oil warms up to at least 75° for the runup. Continental advises that the oil temperature should be at least 100° before beginning the takeoff roll.

On takeoff, the throttle should be advanced slowly and smoothly to allow the manifold pressure to stabilize while the turbocharger spins up. After about 30 inches is reached, the turbocharger spins up quickly to its 41-inch redline. I found that a takeoff setting of 38 inches provides ample power for takeoff and a comfortable margin from the redline. Continental advises that the engine can tolerate a manifold pressure overshoot to 43 inches for less than 10 seconds. The company also warns that manifold pressure overshoots above these limits *will* damage the engine.

The Turbo Arrow shows no inclination to fly itself off the runway, but an assertive tug on the yoke will get the airplane airborne between 70 and 77 knots, depending on load. The airplane accelerates quickly to its best-rate-of-climb speed of 97 knots. After obstacles have been cleared, the power controls should be pulled back to 33 inches and 2,450 rpm for a cruise climb speed of 104 knots. The ground roll for a normal takeoff is about 1,110 feet.

Short-field takeoffs require finesse. The backup gear-extension system must be overridden manually since, in addition to its primary function of automatically extending the gear below an airspeed of about 103 knots, the system also will prevent the gear from being raised below about 78 knots. The system is overridden by pulling a switch located forward of the elevator trim-control wheel between the front seats. With 25 degrees of flap, the aircraft is accelerated to a rotation speed of between 53 and 64 knots. When the gear is retracted, the aircraft is accelerated to its best-angle-of-climb speed, 79 knots, until obstacles are cleared. Piper says the Turbo Arrow requires a horizontal distance of 1,620 feet to clear a 50-foot obstacle on takeoff.

The oil temperature gauge and the cylinder-head temperature gauge (standard equipment on the Turbo Arrow) should be monitored closely while climbing to prevent overheating. The Turbo Arrow has no cowl flaps, and proper engine temperatures can be maintained only by adjusting mixture and airspeed during the climb. Piper says a full-rich mixture should be used during both takeoff and cruise climb.

During an evaluation flight with just myself (150 pounds) and a full 72-gallon usable fuel load aboard on a standard day, the Turbo Arrow averaged 1,200 fpm during takeoff climb, 800 fpm at a 104-knot cruise climb through 12,000 feet and about 500 fpm through 17,500 feet.

With the mixture leaned to 100 degrees rich of peak exhaust gas temperature, the airplane provided a true airspeed of 178 knots at 75 percent power at a density altitude of 16,500 feet, 160 knots at 65 percent power and 150 knots at 55 percent power. At 10,500 feet, the true airspeeds were 160, 148 and 135 knots, respectively.

I used a portable Scott oxygen system during evaluation flights at high altitudes and found it is easy to use but limited in capacity; plus, it takes up a lot of room in the rear seats. This year, Piper is offering the built-in system used in the Turbo Seminole twin as an option. The 48.3-cubic-foot-capacity bottle is located in the tailcone and provides 8.5 hours of oxygen for one

person at 20,000 feet, 4.2 hours for two people, 2.8 hours for three and 2.1 hours for four people.

The optional, built-in oxygen system costs $2,265 and for weight and balance must be accompanied by the optional three-blade propeller ($1,005). It is interesting to note that the external noise level of the aircraft with the three-blade prop is 72.8 decibels, almost 3.4 dB *higher* than the noise level for the two-blade prop. However, while the noise amplitude is higher with the three-blade prop, it is of a different frequency and provides more comfortable perceived sound levels in the cabin.

A close watch on the oil and the cylinder-head temperature gauges also must be kept during descent to avoid supercooling the engine. I found that setting the engine controls for 20 inches and 2,400 rpm, with gear down, provides descent rates of between 1,400 and 2,000 fpm at an indicated airspeed of about 135 knots, well below the maximum structural cruise speed (Vno) of 152 knots. The oil and the cylinder head temperatures stayed well within their green arcs at these power settings. For less hasty descents, 24 inches and 2,400 rpm with gear up and airspeed just below the yellow arc will deliver about 1,000 fpm.

The Turbo Arrow is a pleasure to fly in stable air. The controls are light and well-balanced. Once trimmed in a steep turn, the Turbo Arrow maintains attitude nearly hands-off. However, in turbulence, the airplane tends to wallow quite a bit. This seems to be characteristic of all members of the short-coupled Cherokee series of aircraft. The Turbo Arrow III that I flew also

The turbocharged engine requires strict attention to mixture control and airspeed in climb.

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wallowed in rough air. In the Turbo Arrow III and IV, this is quite uncomfortable, especially at lower altitudes where even low power settings tend to send the airspeed indicators close to or into their yellow arcs.

This year, the Turbo Arrow IV, as well as all other aircraft in Piper's 28 and 32 series, will come with a yoke-mounted transponder ident button as standard equipment. New options, in addition to the built-in oxygen system, include a CG plotter, a digital clock, Century 21 and 41 autopilots and a wider assortment of King, Bendix and Collins avionics systems. The aircraft's list price has been raised from last year's $55,730 to $64,520 this year.

Airworthiness directives have been issued by the Federal Aviation Administration regarding the fuel and the oil lines in the Turbo Arrow and on its fuel-tank vent system. After a rash of service difficulty reports of broken nose-gear downlock assemblies, Piper incorporated a strengthened hook into the assembly in 1977. There also were a number of reports of crankshaft failures in the engines of Turbo Arrows and Senecas. In 1977, Continental beefed up the crankshaft, and Piper and Continental both agree that this has licked the problem. Continental said that a good service history for the TSIO-360-FB engine was what prompted it last year to raise the TBO from 1,400 to 1,800 hours.

The Turbo Arrow offers a good balance of performance, mission flexibility and economy of operation. During a recent round-trip flight between Frederick, Maryland, and Indianapolis—when strong winds and low ceilings prompted me to keep the airplane below 9,000 feet—the Turbo Arrow IV provided true airspeeds between 150 and 165 knots at 75-percent power and burned an average of about 13.5 gph.

Overall, the Turbo Arrow is a very appealing aircraft. Good performance and low maintenance costs make the airplane an excellent choice for personal travel and business flying. □

PIPER PA-28RT-201T
TURBO ARROW IV

Basic price $55,730 (1980)
Price as tested $94,000

Specifications

Engine	Teledyne Continental TSIO-360-FB 200 hp @ 2,575 rpm (sea level to 12,000 ft) Recommended TBO 1,800 hr
Propeller	Hartzell, constant speed, 2-blade (std), 3-blade (opt, as tested) 76 in
Wingspan	35 ft 5 in
Length	27 ft 4 in
Height	8 ft 3 in
Wing area	170 sq ft
Wing loading	17.06 lb/sq ft
Power loading	14.5 lb/hp
Passengers and crew	4
Cabin length	8 ft 1 in
Cabin width	3 ft 3 in
Cabin height	4 ft 1 in
Empty weight	1,690 lb
Empty weight (as tested)	1,881 lb
Useful load (basic aircraft)	1,210 lb
Useful load (as tested)	1,019 lb
Payload w/ full fuel (basic aircraft)	778 lb
Payload w/ full fuel (as tested)	587 lb
Gross weight	2,900 lb
Fuel capacity (std)	77 gal (72 usable)
Oil capacity	8 qt
Baggage capacity	200 lb (26 cu ft)

Performance

Takeoff distance (ground roll)	1,110 ft
Takeoff over 50 ft	1,620 ft
Rate of climb (gross weight)	940 fpm
Max level speed (14,000 ft)	178 kt
Cruise speed (75% power, 10,000 ft)	154 kt
(75% power, 20,000 ft)	170 kt
Cruise speed (65% power, 10,000 ft)	146 kt
(65% power, 20,000 ft)	166 kt
Cruise speed (55% power, 10,000 ft)	136 kt
(55% power, 20,000 ft)	156 kt
Range @ 75% cruise	
(w/ 45-min reserve) 10,000 ft	660 nm
(w/ 45-min reserve) 18,000 ft	695 nm
Range @ 65% cruise	
(w/ 45-min reserve) 10,000 ft	685 nm
(w/ 45-min reserve) 20,000 ft	720 nm
Range @ 55% cruise	
(w/ 45-min reserve) 10,000 ft	740 nm
(w/ 45-min reserve) 20,000 ft	770 nm
Max operating altitude	20,000 ft
Critical altitude	12,000 ft
Landing distance (ground roll)	645 ft
Landing over 50 ft	1,555 ft

Limiting and Recommended Airspeeds

Indicated airspeed, not calibrated

Vsi (Stall clean)	66 kt
Vso (Stall in landing configuration)	61 kt
Vne (Never-exceed)	193 kt
Vno (Max structural cruise)	152 kt
Va (Design maneuvering)	
2,900 lb	124 kt
1,893 lb	96 kt
Vfe (Max flap extended)	108 kt
Vle (Max landing gear extended)	133 kt
Vlo (Max landing gear operating)	111 kt
Vx (Best angle of climb)	79 kt
Vy (Best rate of climb)	97 kt

Based on manufacturer's figures